

ART. XX.—*The Phyllopora of Australia, including descriptions of some new Genera and Species.*

By O. A. SAYCE.

(With Plates XXVII.—XXXVI.).

[Read 11th December, 1902.]

The earliest descriptions of Australian Phyllopora are those of the Rev. R. L. King, published in the Proceedings of the Royal Society of Van Diemen's Land for 1855. Since then the list has been considerably added to by various workers;<sup>1</sup> but frequently the want of figures and more detailed descriptions than have been given, makes it almost impossible to accurately identify the species.

Our thanks are especially due to Prof. G. O. Sars for his very careful redescriptions and figures of old species, as well as for his care in presenting new ones. Besides describing some spirit specimens he has received dried mud from different parts of the continent and successfully hatched out in Norway a considerable number of species, and given valuable information of the life-history of several.

The important treatise of Messrs. Baldwin Spencer and Hall on the Phyllopora of Central Australia in the Report of the Horn Expedition should also be mentioned here, wherein, besides descriptions and figures of new species, records of their distribution and some interesting biological observations are made.

My aim in this paper has been to present a complete catalogue of the Australian Phyllopora, including bibliographical references, and redescriving and figuring more amply those that appeared to need it, and of which I had specimens; also giving sufficient descriptive detail for a fairly accurate identification of each of the others. Unfortunately the material to hand of the several

---

<sup>1</sup> In the Proc. Zool. Soc. London, 1886, Prof. Brady gives a list of species, not only of the Phyllopora, but all the Entomostraca known at that time.

species has been generally insufficient in numbers and often too badly preserved to do justice to them. In most of the groups, particularly the Conchostraca, there is considerable variability of form, and it is difficult to find constantly reliable features, also, what is constant in one genus may be inconstant in another, and throughout the whole order sexually matured species often alter very considerably before reaching the true adult size ; so that a considerable sum of characters must be taken into account, and larger and smaller forms examined, before laying down a good diagnosis.

For material I am specially indebted to Prof. Baldwin Spencer, M.A., F.R.S., and Mr. T. S. Hall, M.A., of the Melbourne University, and to the authorities of the South Australian Museum ; also to several other persons duly mentioned hereafter. I desire further to acknowledge my obligation to Professor Spencer, in his capacity of Director of our National Museum, for affording me the opportunity of consulting certain literature and examining some foreign specimens.

I have considered it necessary to institute two new genera, viz. : *Parartemia* and *Branchinella*, and have described six new species, as well as redescribed and figured several others ; while the list has been somewhat shortened by the cutting out of a few apparent synonyms.

Our present knowledge of the group, however, must not be considered as exhausting the Australian Continent ; very many localities, apparently, have not been searched. It is hoped that further attention will be given to them by field workers, and those possessing collections.

The nomenclature is in conformity with that of Prof. Sars, except as regards the endites of the branchial legs. In these appendages, for the sake of uniformity throughout the group, the so called coxal lobe of the Limnadiidae is considered as the first endite ; allowing by this means the normal number, which is six, each to bear a constant morphological relationship throughout.

*List of Species and their distribution in accordance with the zoological areas instituted by Prof. Baldwin Spencer.*<sup>1</sup>

Each area is denoted by its first letter, and one letter placed above another denotes the borderland of two areas.

*Branchipodidae.*

					PAGE.	
1.	<i>Artemia australis</i> (sp. nov.)	$\frac{E.}{B.}$	-	-	-	229
2.	„ <i>westraliensis</i> (sp. nov.),	E.	-	-	-	230
3.	„ <i>proxima</i>	B.	-	-	-	231
4.	<i>Parartemia zietziana</i> (gen. et sp. nov.),	$\frac{E.}{B.}$	-	-	-	231
5.	<i>Branchinella australiensis</i> (gen. nov.),	T.B.E.	-	-	-	233
6.	„ <i>eyrensis</i> (sp. nov.),	E.	-	-	-	239
7.	<i>Streptocephalus archeri</i> ,	T.	-	-	-	240

*Apodidae.*

8.	<i>Apus australiensis</i> ,	E.	-	-	-	-	241
9.	<i>Lepidurus viridis</i> ,	E.B., also New Zealand	-	-	-	-	242

*Limnadiidae.*

10.	<i>Eulimnadia dahli</i> ,	T.E.	-	-	-	-	244
11.	„ <i>sordida</i> ,	B.	-	-	-	-	245
12.	„ <i>rivolensis</i> ,	B.E.	-	-	-	-	245
13.	„ <i>victoriensis</i> (sp. nov.),	B.	-	-	-	-	246
14.	<i>Paralimnadia stanleyana</i> ,	B., also India?	-	-	-	-	248
15.	<i>Limnadopsis birchii</i> ,	E.	-	-	-	-	249
16.	„ <i>tatei</i> ,	E.	-	-	-	-	250
17.	„ <i>brunneus</i> ,	T.	-	-	-	-	250
18.	<i>Estheria packardi</i> ,	E.B., also India?	-	-	-	-	250
19.	„ <i>elliptica</i> ,	E.	-	-	-	-	252
20.	„ <i>sarsii</i> (sp. nov.),	E.	-	-	-	-	252
21.	„ <i>lutraria</i> ,	E.	-	-	-	-	254

<sup>1</sup> These areas are named and defined as follows:—1, Northern and north-eastern coastal, extending as far south as about the Clarence River, and including also New Guinea—Torresian. 2, Southern-eastern coastal area, including Southern Victoria and Tasmania—Bassian. 3, The whole of the interior, together with West Australia and almost all South Australia—Eyrean. See Rep. Horn Exped. Summary, pp. 196-199.

	PAGE.
22. <i>Estheria dictyon</i> , E. - - - - -	255
23. <i>Cyclestheria hislopi</i> , T., and India - - - - -	256

*Lynceidae.*

24. <i>Lynceus macleayana</i> , B.E. - - - - -	258
25. „ <i>tatei</i> , B. - - - - -	258
26. „ <i>eremia</i> , E. - - - - -	258

Sub-order PHYLLOPODA.

Entomostraca of various shapes, with or without a carapace or shell; the possessors either having it fashioned as a dorsal shield, or in the form of two large valves enveloping the entire animal. Eyes sometimes pedunculated, sometimes sessile. Ocellus (simple eye) present. All the appendages placed behind the mouth parts respiratory, of approximately uniform structure and leaf-like form; their number very variable, 10-63. (This description does not include the Cladocera).

*Remarks.*—Prof. G. O. Sars has divided this sub-order into three groups. They are of widely separated types, those without any carapace or shell (Anostraca), those with a large chitinous shield arching over the back, which in outline is of horseshoe shape (Notostraca), and those with the body surrounded by a large chitinous bivalve shell, connected dorsally, and capable of being opened or shut by the aid of powerful adductor muscles, so that the animal may be entirely enclosed.—(Conchostraca).

None are marine inhabitants, and, with the exception of but very few forms which live in salt inland waters, are only found in fresh water, and usually in quiet shallow lakes or pools (often less than a yard across), which completely dry up periodically. They range in length from a quarter inch to three inches.

Their growth is often surprisingly rapid; Messrs. Spencer and Hall mention in the Report of the Horn Expedition to Central Australia that in only a few days after a fall of rain numberless specimens of *Apus*, measuring  $2\frac{1}{2}$  inches in length, were seen swimming about the rain pools which could only have come from eggs. Probably the high temperature of the water is a stimulus for this strikingly rapid development.

Tribe 1—*Anostraca* (Naked Phyllopods).

Body long, very soft and flexible, and without any trace of carapace or shell. Eyes distinctly pedunculated. First pair of antennae small and filiform; second pair in the male formed into a clasping organ; in the female of a simple character.

Family 1—*Branchipodidae*.

Body narrow, cylindrical, somewhat thicker in front, with the tail well developed, and distinctly segmented in both sexes, terminating in two bristle-beset caudal rami. Prehensile antennae of male distinctly segmented, and usually furnished with a rudimentary sub-branch. Frontal appendages present in the male or wanting. Eleven pairs of branchial feet present, all having a single serrated external covering plate. Marsupium of the female distinctly sac-formed, directed backwards, and issuing from the two foremost caudal segments.—(Sars).

## SYNOPSIS OF LOCAL GENERA.

(A) *Tail with eight segments*—

1. Male claspers with 2nd joint flat and triangular; caudal rami very small.—ARTEMIA.
2. Male claspers with 2nd joint claw-shaped; immovable spiniform projection on frontal area of 1st joint, caudal rami very small.—PARARTEMIA.

(B) *Tail with nine segments*—

3. Frontal appendages simple, spinulose, united proximally, varying greatly in length; claspers quite simple, 2nd joint claw-shaped, not angularly bent near the tip; 2nd antennae of female very long and ribbon-like; ovisac stout, pear-shaped.—BRANCHINELLA.
4. Frontal appendages long, variously lobed, and spinulose; claspers with 2nd joint possessing a sharp basal spur; ovisac short and broad, eggs large, and few in number.—CHIROCEPHALUS.
5. Second joint of male claspers long, twisted, and forked irregularly; ovisac long and slender.—STREPTOCEPHALUS.

Genus 1—*Artemia*.1. *Artemia australis*, sp. nov. (Pl. XXVII.).

*Description of Female*.—Body normally slender; tail of eight segments, equal in length to cephalon and trunk combined, terminal segment as long as the two preceding ones combined; caudal rami narrow-lanceolate, about half the length of the terminal segment, not articulated to it. Eyes large and prominent.

First antennae relatively long. Second antennae lanceolate, a little shorter than the first pair, gradually tapering from about the middle of the length to an acute tip, but not drawn out. Branchial feet each possessing the normal number of divisions. First pair very small, rather smaller than the last. Each with distal lobe of endopodite very broad, much broader than the length of the exopodite, except in the last pair, where it is of about equal length; in each it is laterally produced considerably beyond the level of the upper endites, with the margin evenly curved, and merging into the distal margin, which runs in an almost straight line to the proximal end of the exopodite. In each pair of feet except the last, the second endite, as usual, is scarcely marked off from the first one, and at its origin there is a little tubercle; in the last pair it is much smaller but more conspicuous, and from its edge arise three much larger setae than those on the first endite. In each of the other legs the two first endites are uniformly fringed with feathered setae, curving upwards. The third endite bears one very long, stout spiniform setae and one shorter one, the former twice as long as the latter; the fourth endite has two and the fifth one stout setae, similar to the shorter one on the third endite. The exopodite is about twice as long as its greatest breadth, and bluntly pointed at the end.

Ovisac, very stout, fully as broad as its length, the anterior part much swollen and possessing two lateral subconical lobes. On the deeply convex ventral surface there are two acute tubercles, set one on each side of the mid axis. The neck is short and extends to about the end of the fourth tail segment.

*Length*.—9.5 mm., exclusive of caudal rami.

*Locality.*—Brackish-water, Sandhills, Glenelg, coastal district of South Australia. (S.A. Museum, collected by Mr. Becker, 1890).

*Remarks.*—Of this species I have received about 100 specimens, all of which are females and several bearing eggs, but the greatest number are young forms not fully matured, and probably of parthenogenetic origin. It is to be regretted that there are no males amongst them, but I think there is little doubt as to their being a normal *Artemia*.

2. *Artemia westraliensis*, sp. nov. (Pl. XXVIII,  
Figs. A1 and 2).

*Description of Female.*—Body of normal form; tail of eight segments, about equal in length to cephalon and trunk combined, terminal segment only about one-third longer than the preceding one, caudal rami narrow-lanceolate, very long for the genus, being of sub-equal length to the terminal segment, and thickly fringed with feathered setae. Eyes smaller and scarcely so prominent as those of *A. australis*.

First antennae short and slender, subequal in length to the eye and its stalk. Second antennae short, slightly longer than the first pair, broad-lanceolate, apically gradually tapering to an acute point. Branchial legs agreeing closely in shape to *A. australis*.

Ovisac differing proportionately in shape from *A. australis*, due to the lateral lobes being very much more developed (in this species swelling out on each side to enormous saccular distentions), and a correspondingly smaller neck; also there are no acute tubercles on the ventral face. It is considerably broader than long, and does not extend as far as the end of the third tail segment.

*Length.*—11 mm., exclusive of caudal rami.

*Locality.*—Lake Aurean, Murchison, West Australia. (Collected by Mr. J. T. Markes, January, 1896).

*Remarks.*—I have but two female specimens of this species, both are of similar size, and well preserved. It may be that it is congeneric with the following species, but without the male it is impossible to say.

I am informed by a resident of Murchison that the water of Lake Aurean, from which this species was taken, is always more or less brackish, but never very salt. During the rainy season it is quite fit for cattle to drink. In the same bottle as contained the specimens there was a specimen of *Apus australiensis* and a new species of *Estheria*, described later in this paper, all, according to the label, collected from the same place at the same time.

## UNRECOGNISABLE SPECIES.

*Artemia proxima*, King.

*Ref.*—Proc. Royal Soc. Van Diemen's Land, 1855, p. 70. Trans. Entom. Soc. New South Wales, I., p. 162, pl. xi.

No figure except a branchial leg of the fifth pair has been published, and the few words of description are quite meaningless. The specimens were collected from salt pans at Newington, near Sydney.

Genus 2—*Parartemia*, nov.

Body slender; tail slender and elongated, of eight segments, the terminal one long; caudal rami not articulated to the terminal segment, of flattened form and very short.

Prehensile antennae of male large; first joint short and very stout, directed obliquely outwards, inner margins definitely formed, so that the pair together fit closely over the back of the female during copulation, also on the frontal face of each an immovable spiniform process, presumably homologous with the frontal appendages of other genera; second joint quite simple, claw-shaped, incurved, slender, and of firm consistency.

Branchial feet with the normal number of parts; distal lobe of endopodite, short and rather broad, produced somewhat laterally, but apparently not so much as in *Artemia*; exopodite narrow. Last pair without covering plate or gill.

Ovisac of female very short and broad, of trilobate form, due to two very large lateral saccular lobes narrowly united ventrally, and medianly therefrom abruptly arising a short and stout neck.

*Remarks.*—This new genus is formed to receive the following new species. It agrees in many respects with *Artemia*, but



differs from it materially in the shape of the prehensile antennae of the male, and the ovisac of the female, and also in some other characters.

**Parartemia zietziana**, sp. nov. (Plates XXVIII., Fig. B, and XXIX.).

Body slender; tail greatly elongated, about one-third longer than the cephalon and trunk combined, terminal segment fully twice as long as the preceding one. Cephalon large, as long as first four segments of trunk combined. Eyes small and prominent.

First antennae short. Prehensile antennae of male, as usual, directed downwards; first joint with bases coalesced to each other, short, stout, fleshy, subquadangular in frontal outline and widely divergent, so that the distal ends face obliquely outwards, to which are articulated the second joints. These are twice as long as the first joint, of firm consistency and slender cylindrical shape, curving but a little inwards, gradually tapering from the base to a finely pointed extremity, and the surface unbroken by any ridges or spines. From the middle of the anterior surface of each basal joint, and directed anteriorly, arises a prominent immovable spineform process, while from the inner side which faces directly downwards, there is projected a definite ridge extending nearly to the distal end of the joint, having the margin concave. The pair of ridges are only separated medianly by a very narrow fissure, and together form a concave space which fits over the back of the female during copulation. The distal angle of each ridge is narrowly rounded and a little produced towards the end of the joint.

Second antennae of female about the length of the head, obliquely truncated at the end with the inner angle drawn out to an acute point.

Branchial feet of shape normal to the genus, no difference in the two sexes; covering plates rather small, gills of about similar size. Endopodite with terminal lobe broad and laterally expanded more or less, those pairs of about the middle area being very much so, side margin meeting the distal end in a broad even curve, and fringed with spiniform setae, the end being only a

little curved, and bearing longer and finer bristles. The first endite is of usual shape, that of the first pair bearing at about the middle of the length a particularly stout, long, and acutely pointed spine directed upwards and slightly curved, and bearing on the distal half many minute barbs. The second endite is about one-third of the length of the first. The third, fourth and, fifth small and subconical, each gradually becoming smaller and bearing several of the usual long feathered setae, also one long finely feathered spine and one very short one, that of the third being very long. The exopodite is long, rather narrow, and apically bluntly pointed. The last pair of feet have no basal plate, nor gill, and is smaller in size than the first pair.

Penes double, wide at the base, hind margin straight, front, in the middle, having a wide and deep sinus, defined above by a right-angle, and below by a conical pointed projection. Ovisac scarcely extending beyond the second tail segment, lateral lobes very large, widely divergent, and extending dorsally far beyond the level of the back, ventrally narrowly united, not bulging at all outwards, neck very short and thick, and pointing directly outwards.

Caudal rami less than one-third the length of the ultimate segment, of flattened form, with the extremity broadly rounded, and the edges thickly fringed with feathered setae.

*Length.*—♂ 23 mm. ♀ 18 mm.

*Locality.*—Brackish-water swamp near Lake Alexandrina, South Australia. (S.A. Museum, collected November, 1890).

*Remarks.*—Of the specimens received about 20 are males of pretty uniform size, and only one female of rather smaller size. It is named in compliment to Mr. A. Zietz, F.L.S., Assistant Director of the South Australian Museum.

### Genus 3—*Branchinella*, nov.

*Characters.*—In general appearance like *Branchipus*; body stout, tail of nine segments besides the caudal rami, the latter well developed and articulated to the terminal segment. Cephalon large. Eyes large and prominent. Prehensile antennae of male without any spur or accessory branch other than the frontal appendages, basal joint stout and fleshy and of cylindrical form, second joint very much narrower, quite simple, firm and chiti-

nous, curved evenly inwards, not at all angularly bent near the tip, inner surface usually bearing transverse ridges. Frontal appendages simple, spinulose, minute to very long and flexuose, proximally coalescent and united to the frontal base of the claspers.

Second antennae in the female very long, flattened, flexuose, apically tapering to a point; in fully matured forms often extending as far back as the limit of the trunk.

Branchial feet possessed with the usual parts; covering lamellae large; exopodite large, broadly ovoid; distal lobe of endopodite well extended, ventral margin distinctly emarginated, inner margin substraight, scarcely or not at all produced beyond the level of the endites; endites clearly marked off from the stem.

Ovisac large and stout, of pyriform shape, posteriorly tapering to a rather long neck. Eggs numerous, generally marked with facets bordered by raised ridges.

Male with a pair of penes, each lying introverted within a simple unnotched sheath protruding a little from the segment; when everted, of subcylindrical shape, long and spinulose.

*Remarks.*—This new genus is instituted to receive the two following Branchipods. From Branchipus, with which they accord closely in very many respects, they differ in the male claspers being without any accessory branch or spine, and the terminal joint not being at all angularly bent near the tip; also in the long and ribbon-like second antennae in the female, and apparently in the peculiarly characterised penes of the male. From Chirocephalus, with which the second species might be placed if we relied on the frontal appendages, there are other differences of more generic importance which appear to separate it from that genus.

### 1. *Branchinella australiensis*, Richters.

(Plate XXX.)

*Branchipus australiensis*, Dr. F. Richters, *Journal de Muséum Godeffroy*, xii., 1876, pp. 43, 44, pl. 3.

*Specific Characters.*—Body stout, cephalon of about equal length to the first four segments of trunk, trunk of equal length

to the tail. Branchial feet each with covering plate very large, distal lobe of endopodite (6th endite) rather short, broadly rounded in average sized sexually matured specimens, but in larger ones much longer, and narrower distally, often produced considerably beyond the end of the exopodite. Distal margin emarginate.

In each of above characters the two sexes agree. *Male* of smaller size than female, and antennules longer. Claspers large and powerful, basal joint with inner surface clothed with minute teeth, second joint longer than the first, inner surface possessing transverse ridges. Frontal appendages minute, simple, curled inwards and downwards, their inner margin minutely spinulose, united proximally, and attached to frontal base of antennae. Caudal rami at least as long as the last four segments of tail combined, (in female somewhat shorter). Sheath of penes not notched, penes, when everted, stout, bent outwards and hindwards in the shape of a sickle, distal half thickly clothed with short recurved spines, proximal half possessing large, stout, acute spines pointing proximally.

*Female*.—Second antennae very long, flattened, flexuose, gradually narrowing to a somewhat drawn-out, pointed end; sometimes they extend as far back as the end of the trunk, but in younger although sexually mature forms often very much shorter. The ovisac large, pear shaped, with apex elongated, and furnished on the ventral surface, in a line with the extremity of the first segment of the tail, with a small protruding transverse ridge or lip. In forms bearing eggs the ovisac varies in size, extending in some to the end of the fourth, and in others to the sixth segment of the tail. Eggs sculptured with irregular hexagonal facets bounded by conspicuous ridges.

*Length* of largest ♂ exclusive of caudal rami, 30 mm. Length of largest ♀ exclusive of caudal rami, 40 m.m.

*Colour*.—Translucent, caudal rami vivid reddish-orange, ovisac flecked with patches of sky blue.

*Distribution*.—Queensland, inland area (Dr. Richters); Elwood and Rosstown, Southern Victoria (collected by Mr. R. Cummins, B.Sc.); Goornong, near Bendigo (collected by Mr. Alex. Purdie), St. Arnaud (collected by Mr. C. J. Gabriel), both Northern Victoria; coastal area of South Australia and Central Australia (S.A. Museum).

*Remarks.*—This large and handsome Branchipod has not previously been recorded outside of Queensland. Besides other localities it is quite common near Melbourne (Elwood and Rosstown), except when the little rain pools in which they live dry up, such being the case for several months every year. I have never known them to live in the larger swamps that contain water all the year round.

The original paper of Dr. Richters describing this species from Queensland has apparently been entirely overlooked, for in Professor Packard's important monograph of the Phyllopods of North America, published seven years later than the above paper,<sup>1</sup> in which he gives a list of known species of the family, it is not included, and he remarks that no Branchipodidae occur in Australia, which misstatement has been made since. Sars also has missed the above record in his list of Australian Phyllopoda.<sup>2</sup>

My thanks are due to Mr. T. S. Hall, M.A., for bringing under my notice Richters' paper, and I have no doubt from comparison with his figures and description that the Victorian form specifically agrees with it. I have, however, thought it advisable to more fully describe it. The foregoing description and following supplementary remarks have been made after an examination of numerous living specimens.

*Supplementary Description.*—The males and females live in about equal proportion. They are of graceful form, and, like other Branchipods, swim on their back by the aid of eleven pairs of large, leaf-like appendages, which, as is well known, serve also for respiration, and are kept in rhythmic undulation. When occasion warrants they are able to propel themselves rapidly by strong jerks with their long tail, which is provided at the end with a pair of large feathered appendages. By the movement of the branchial feet a current of water is formed that flows from behind forwards between the two rows of feet, and in this way the food reaches the mouth.

The trunk or mesosome is somewhat broader than the cephalon, and is formed of eleven segments which are of subequal length and breadth. The tail, or metasome, is formed of nine segments,

<sup>1</sup> Twelfth Annual Report of U.S. Geol. and Geog. Survey for the year 1878, part i. (1883).

<sup>2</sup> Arch. for Math. og Naturvid, Christiania, xvii., No. 2.

the first two (genital segments) are partly coalescent and bear on the ventral surface the two penes and ovisac of the respective sex, the remaining seven gradually become narrower hindwards. The cephalon is divided into an anterior part and a so-called cervical segment; the anterior part is broadest posteriorly, the stalked eyes are large and prominent, the ocellus, or simple eye, minute, the antennules long and filiform, and extending in the males to about the end of the basal joint of the claspers. In the females they are relatively slightly shorter.

The labrum, or anterior lip, is large and curves below, where it covers the lower part of the powerful mandibles. Viewed from below it is of the usual triangular shape, with the apex pointed hindwards.

The branchial limbs are borne by the eleven segments of the trunk, and gradually increase in size towards the middle, then gradually become smaller posteriorly. They are of normal form and size, the covering plates very large and their outer margins serrated, the gills much smaller and of ovoid shape, the exopodite broadly ovoidal, with outer margin almost straight, inner strongly and evenly curved from the proximal to the distal extremity. The distal lobe of endopodite (6th endite) is short and broad in average sized specimens (Fig. 7), in larger ones longer and proportionately narrower. The inner side is never produced beyond the level of the endites above, and the distal margin is distinctly excavated, most noticeable in the limbs of the middle area; inner margin more or less strongly curved (least so in matured forms), and evenly merged into the distal margin. There is no fundamental difference in the two sexes.

The terminal segment is short, and from it the caudal rami extend posteriorly and somewhat divergent, and are rather longer in the males than females; they are dorso-ventrally flattened, and taper gradually from the base to the narrowly rounded extremity, the lateral margins and end being fringed with long feathered setæ.

In mature females the ovisac is pear-shaped, with the apex elongated, but is subject to considerable differences of size and, in a lesser degree, shape. I have found ripe eggs in forms where its distal extremity only extended to slightly below the end of the third segment of the metasome (Fig. 1), and others, but

larger forms, where it extended to the end of the sixth segment (Fig. 3), and in these the shape was more conical. The opening at the end of the ovisac is guarded by two somewhat protuberant lips, the dorsal one somewhat overlapping the ventral one. On the ventral surface in the mid axis, towards the anterior end, the wall of the ovisac projects to form a prominent and somewhat narrow ridge, or lip; this possibly is of use during copulation.

In males the testes (Fig. 4) of each side mostly lie near the surface in the first segment of the metasome, which is somewhat swollen, and this portion of them is very much coiled, and plainly to be seen from the outside. From this segment they extend into the third segment, but run further from the surface in a straight line on each side of the intestine, and are only to be seen on careful dissection. On this account it may be that Dr. Richters' description is due to a mistake, for he says that this species is peculiar to the genus in that the testes are only situated in the first segment of the tail.

The vas deferens of each side runs directly into the second segment, and protrudes outwards for a short distance; this portion, which I refer to in this paper as the sheath of the penis, is partly guarded by an angular projection of the wall of the segment. Several specimens were noticed with two long and comparatively stout cylindrical processes, the penes, comparable to the cirri of some writers, which were bent outwards and hindwards in the form of a sickle (Figs. 5 and 6). These have the distal half of the surface facing inwards very rugose, while more proximally there are several stout spines. The outer surface has the distal half thickly studded with minute spines, and along the whole length of each side there is a longitudinal row of stout, acute, re-curved spines, with swollen bases, which increase in size proximally.

On dissecting a specimen in which the penes were not projecting outwards it was found that each were lying reflected backwards (introverted) within the lumen of their respective sheath, with the distal extremity extending to almost as far back as the testes. It is clear, therefore, that the contents of each testis are forced outwards by muscular contraction, and each penis becomes pushed outwards (everted) in consequence of the pressure of the seminal fluid behind, so that what was the innermost wall of the

penis when lying within the lumen of the sheath becomes the outermost, and each penis becomes inflated with seminal fluid. When one or both of the penes enter the ovisac it would seem on structural grounds as if they were prevented from being withdrawn in consequence of the large recurved spines, and must perforce be left behind after copulation. I have, however, never found any remains of them in the ovisac bearing mature eggs. When once the penes are everted, there do not appear to be any muscles to enable them to be again introverted.

## 2. *Branchinella eyrensis*, sp. nov. (Pl. XXXI.).

Body of normal form, tail, exclusive of caudal rami, about one-fourth shorter than the cephalon and trunk combined. Caudal rami in the male as long as the four terminal segments combined. Frontal appendages very long and ribbon-like, extending much beyond the limit of the claspers, united proximally for about one-third of their length and bearing stout spines only. Claspers of normal form, second joint evenly curving inwards, of similar length to first joint, inner surface with very strongly marked transverse ridges. Second antennae of female apparently similar to those of *B. australiensis* (incomplete in my specimens).

Branchial feet with distal lobe of endopodite narrower and longer than in *B. australiensis*, those of the middle area in specimens of about 33 mm. in length, with the inner and outer margins converging to a narrow apex, which is emarginated in the middle. Gills subcircular in outline.

Ovisac without any projecting lip or ridge on ventral surface. Penes when everted from their sheaths of very great length, extending as far back as the penultimate tail segment, normally spinulose.

*Length*.—Male, exclusive of caudal rami, 33 mm.; female a little longer, but one specimen, locality unknown, fully 50 mm.

*Distribution*.—Water holes, Upper Onkaringa Creek, Central Australia (S.A. Museum, collected during Elder expedition, May, 1891). One female, Wintinorina, near Lake Eyre (collected by Mr. H. J. Grayson).

*Remarks*.—Five specimens were received, and all of about similar size. In general appearance they are very like *B.*



australiensis, but are conspicuously characterised in the male by the very much greater length of the frontal appendages and penes, and in the female by no lip existing on the ventral surface of the ovisac. The feet also of the middle area have the terminal lobe of the endopodite considerably narrower distally.

Genus 4—**Streptocephalus**, Baird, 1854.

**Streptocephalus** (?) *archeri*, G. O. Sars. Arch. for Math. og Naturvid, Christiania, xviii., No. 8, pp. 4-13, pl. 1.

This species was described from a single female specimen that had been raised from dried mud from a waterhole, salt at high tide, 20 miles from Rockhampton. On account of the sex its generic position is uncertain. The following is an abbreviation of Sars' description.

*Female*.—Body very slender, with the trunk about the length of the tail (excluding the caudal rami). Head exhibiting on the dorsal face a small, but well-defined, rounded quadrangular and somewhat elevated area. Eyes comparatively large. Antennulae narrow and elongated. Antennae about the length of the antennulae, applanated, foliaceous, not compressed, and having at the obtusely rounded tip a very short pointed projection. Legs apparently of the usual structure, outer part of endopodite broadly rounded, exopodite lamelliform, much smaller on the first than on the succeeding pairs, basal plate minutely and regularly serrated. Ovisac rather short and narrow, scarcely reaching beyond the second caudal segment; enclosed ova of a very peculiar shape, being each surrounded by a tetrahedric shell. Caudal rami very much elongated, being about half the length of tail proper, and rather narrow, tapering distally, and fringed all round with strong plumose setae. Body, in the living state of the animal, highly pellucid, nearly colourless, caudal rami, however, tinged with a vivid reddish-orange. Length of adult female, 9 mm.

UNRECOGNISABLE SPECIES.

**Chirocephalus**, sp.

Mr. T. Whitelegge says in his list of Invertebrate Fauna (Journal Royal Soc. N.S.W., xxiii., 1889, p. 318) that there are

three examples in the Australian Museum, which were collected from near Yass, N.S.W., that are distinct from the European species.

Tribe 2.—*Notostraca*.

Phyllopods with body more or less covered above by a broad vaulted carapace, which is united anteriorly with the head.

Family *Apodidae*.

Carapace broadly rounded in front, slightly vaulted and indented behind, with a distinct transverse cervical furrow defining the head posteriorly; the latter shovel-formed and exhibiting a crescent-shaped ventral duplicature, behind which the antennae and oval parts are situated. Hind part of the body projecting more or less behind the carapace, and divided into numerous segments, encircled by fine spikes. Caudal filaments very much elongated. Males very rare, considerably smaller than the females, and without special prehensile organs. (G. O. Sars, in part).

*Remarks.*—This family contains only two genera, which are closely allied, and have a world-wide distribution. Each is represented in Australia.

SYNOPSIS OF THE GENERA.

1. Last caudal segment not prolonged between the caudal filaments to a lamellar expansion.—*APUS*.
3. Last caudal segment bearing a lamellar expansion.—*LEPIDURUS*.

Genus 1—*Apus*, Schaeffer, 1756.

*Apus australiensis*, Spencer and Hall.

*References.*—Spencer and Hall, *Victorian Naturalist*, vol. xi. (1895), p. 161. Spencer and Hall, *Report Horn Expedition to Central Australia*, part ii., *Zoology*, pp. 231-234, pl. 20, figs. 1-3. Sars, *Arch. for Math. og Naturvid*, Christiania, xix., No. 1, pp. 5-12, pl. i. and ii.

*Distribution.*—West Australia, South Australia, inland area of New South Wales, and northern area of Victoria.

Genus 2—*Lepidurus*, Leach.

*Lepidurus viridis*, Baird.

1850. *Lepidurus viridis*, Baird. Proc. Zool. Soc. Lond., p. 254, fig. 1.  
 1866. *Lepidurus angasii*, Baird. Proc. Zool. Soc. Lond., p. 122, fig. 1.  
 1878. *Lepidurus kirkii*, G. M. Thomson. Trans. New Zealand Inst., xi., p. 260, pl. ii., fig. E4.  
 1878. *Lepidurus compressus*, G. M. Thomson. Trans. New Zealand Inst., xi., p. 260, pl. ii., fig. E5.  
 1879. *Lepidurus viridulus*, Tate. Proc. Royal Soc. South Australia, 1878-9, p. 136.  
 (?) 1894. *Lepidurus angasii*, G. O. Sars. Arch. Naturv., Christiania, xii., pt. 2, No. 7, pp. 4-13, pl. i., fig. 1-15.  
 1896. *Lepidurus viridis*, Spencer and Hall. Report Horn Expedition to Central Australia, pt. ii., Zoology, p. 233.

This species is by no means uncommon in rain-water pools in the neighbourhood of Melbourne, and also inland.

*Distribution.*—Inland and coastal areas of N.S.W.; northern and southern areas of Victoria; southern area of South Australia; Tasmania; and New Zealand.

Tribe 3—*Conchostraca*.

*Characters.*—Phyllopoda, with body surrounded by a large bivalved shell, so that the animal may be completely enclosed. Often bearing a striking resemblance to certain bivalved Mollusca.

Family 1—*Limnadiidae*.

*Characters.*—Shell generally compressed and furnished, in the full-grown animal, with a varying number of lines of growth. Head of medium size, and only slightly different in the two sexes.

Trunk elongated and very movable; caudal part well developed, curved downwards, forming posteriorly two juxtaposed dentated lamellae, and terminating in two movable claws. First pair of antennae more or less elongated, and generally lobed in one margin; second pair with slender rami, considerably longer than the scape. Masticatory part of the mandibles without distinct teeth. Legs numerous (16-28 pairs), with comparatively short endites; dorsal lobe of exopodite in the female elongated, in two or three of the middle pairs, into filiform appendages, supporting the egg-mass. (G. O. Sars).

## SYNOPSIS OF LOCAL GENERA.

(A) *Head possessing a frontal clavate process* ("haft" or "affixing" organ). First two pairs of legs in male prehensile.

1. Shell much compressed, thin, ovoidal, pellucid, lines of growth inconspicuous, few; no trace of umbones. Animal not crowded within the shell; about 18 pairs of feet. Bisexual.—EULIMNADIA.
2. Shell much compressed, parchment-like, dorsum possessing a longitudinal series of spiny processes; lines of growth conspicuous ridges; umbones minute. Feet numerous, 26-32 pairs.—LIMNADOPSIS.
3. Shell compressed, rather thin, male differing very considerably from female in form; lines of growth inconspicuous, very numerous; umbones large and prominent. Otherwise like Eulimnadia.—PARALIMNADIA.

(B) *Head without a frontal appendage*. Shell with more or less prominent umbones.

4. Shell orbicular, thin, smooth, lines of growth few (about 7). Antennulae simple; only first pair of legs in male prehensile.—CYCLESTHERIA.
5. Shell oval, more or less globose, generally brownish in colour, lines of growth conspicuous, numerous (about 10-20). Antennulae lobed. First two pairs of legs prehensile in the male.—ESTHERIA.

Genus 1—*Eulimnadia*, Packard, 1874. (Pl. XXXIV.,  
Figs. 1a, b, c).

1. *Eulimnadia dahli*, G. O. Sars.

*Reference*.—Arch. for Math. og Naturvid, Christiania, xviii., No. 8, pp. 14-30, pls. ii.-vi.

*Specific Characters*.—Shell in both sexes of same appearance, very thin and pellucid, without any trace of umbones; seen laterally, of a rather regular elliptical shape, with the height but little more than two-thirds of the length, dorsal margin evenly vaulted, and having its greatest convexity somewhat in front of the middle, ventral margin forming a perfectly even curve, and joining the anterior and posterior edges without any intervening angle, both extremities nearly equal, obtusely rounded at the tip, and having above a distinct angle; seen from above, narrow fusiform, the greatest width in front of the middle. Maximum number of lines of growth only four pairs. Head having in both sexes the frontal part considerably produced; rostrum in female very short and obtuse, being only defined in front by a slight sinus; that of male considerably more prominent, terminating in an acute point. Antennae and oral parts of the usual structure, excepting that the posterior maxillae are quite rudimentary. Legs, 20 pairs, having the epipodites of considerable size; the two anterior pairs in male very strong, subchelate. Tail with two short, juxtaposed dentiform projections in front of the caudal claws, the latter, throughout the greater part of their length, fringed posteriorly with long ciliated setae, caudal plates terminating below in a very acute, straight corner, and having the posterior edge divided into 12-16 small denticles; dorsal spines present only in a single distinctly developed pair.

*Length* of shell in female attaining 7 mm.; in male, 5.50 mm. (G. O. Sars).

*Locality*.—Neighbourhood of Port Darwin, Northern Australia (Sars); Charlotte Waters, Central Australia (collected by P. M. Byrne, Esq., March, 1896).

*Remarks*.—A considerable number of specimens that I have from Charlotte Waters are undoubtedly this species. They agree very closely with Sars' description and figures in all respects

except in not possessing a rudimentary joint to the fifth endite of the fourth pair of legs in the male; also the shells of the female are frequently considerably more vaulted, but except for this, which appears to be a variable feature in other species of this genus, the shape is in exact agreement.

## 2. *Eulimnadia sordida*, King.

*Linnadia sordida*, King. Proc. Royal Soc. Van Diemen's Land, 1855, p. 70.

King gives no figure, and the only description is—"Branchial legs as in *Linnadia stanleyana*, 3rd finger of tridactyle feet, three-jointed; last segment of the body with 19 or 20 spines on each side. This species is larger than *L. stanleyana*, and bears considerable resemblance to *L. mauritiana* (Grevin)."

*Locality*.—Pond near Botany Bay, N.S.W. (King); Moore Park, near Sydney, N.S.W. (Whitelegge).

*Remarks*.—I am inclined to regard *E. rivolensis*, Brady, as a synonym of this species, but without examining specimens from the original locality it is impossible to say; it is certainly congeneric with it. The subapical process of the two first pairs of legs are three-jointed; also it agrees in the number of dorsal denticles of the tail.

## 3. *Eulimnadia rivolensis*, Brady. (Pl. XXXII.).

Brady, Proc. Zool. Soc. London, 1886, p. 87, fig. D.; Spencer and Hall, Report Horn Expedition, pt. ii., p. 238.

*Description*.—Shell greatly compressed, thin, smooth, and parchment-like, without any trace of umbones, lines of growth scarcely discernable without staining, comparatively numerous, crowded very closely together for a short distance at the margin (number about 6), afterwards abruptly much wider apart (about 5); none on the umbonal region nor for some distance surrounding it; all meeting closely together at the antero-dorsal angle. *Male* in lateral view rather narrowly ovoidal in fully matured specimens, but in younger ones shorter and relatively broader behind; back evenly arched, varying considerably in degree of convexity; greatest convexity a little in front of the middle; front deep and boldly rounded, curving a little beyond the end of the

hinge without any definite angle, thence receding in a bold curve to join the ventral margin; the latter almost straight, posteriorly ascending somewhat and merging into an evenly rounded tip. *Female* of similar shape, but with back more vaulted.

Head with rostral expansion in female short and generally acute at the tip, but sometimes obtuse like *E. dahli*; in the male, compared with that species, very much longer, and not acutely, but bluntly, pointed.

Legs, 20 pairs. Male with two first pairs of legs subchelate, subapical appendage long, three-jointed; hands in lateral view subquadrate, inner margin above the thumb-like projection with an angular prominence. Fourth leg not having a rudimentary joint to fifth endite as in *E. dahli*, remaining pairs as in the female, except that in the latter the ninth and tenth pairs have the proximal lobe of the exopodite with a long thread-like appendage. Tail long, with the two longitudinal dorsal ridges almost straight, each possessing very many (about 20) acute little denticles, also from 3-5 pairs in front of the anal setae only slightly larger than the others. Movable caudal claws evenly curved upwards, and not more than the proximal half bearing feathered setae; in *E. dahli* they are much straighter, and the greater part of their length bears feathered setae.

*Size*.—♀, length about 9 mm., width variable; ♂, rather less in length and proportionately narrower.

*Distribution*.—Neighbourhood of Rivoli Bay, South Australia (Brady); Upper Onkaringa Creek, Central Australia (S. and H.); Cheltenham, Southern Victoria; and, if my supposition of its being synonymous with *E. sordida*, King, is correct, also New South Wales.

*Remarks*.—I have been enabled to examine specimens of this species collected from the same neighbourhood as the types came from, also a few specimens from Victoria. The latter agree in all respects with the former except that the shape of the shell posteriorly is deeper and more broadly rounded. As in other species of *Eulimnadia* males occur in much fewer numbers than females.

#### 4. *Eulimnadia victoriensis*, sp. nov. (Pl. XXXIII.).

*Description*.—Shell smooth, very thin and translucent, much compressed, without any umbones; lines of growth inconspicuous,

maximum number four, meeting closely together at antero-dorsal angle. In male, seen from the side of oblong shape, back evenly arched, front deep, not produced in the least beyond the antero-dorsal angle, subtruncated, then receding in a bold even curve, and merging into the ventral margin; posterior considerably narrower than anterior margin, and merging into the ventral margin in a wide, even sweep. That of female agreeing with the male, except that the back is more vaulted, often very much more so, the width being sometimes fully three-quarters of the length; its greatest convexity a little in front of the middle.

Male with two first pairs of legs having hands rather slender, a little longer than broad, gradually widening distally, only a barely perceptible rounded prominence above the thumb on the inner margin; subapical appendage two-jointed, that of second not very much longer than in the first pair. Third legs with fifth endite short and broad, and its cylindrical appendage rather short; exopodite comparatively long, and extending not far short of the extremity of the cylindrical appendage. Fourth legs without any rudimentary joint on the fifth endite. Remaining pairs without any apparent difference from *E. rivolensis*. Each of the legs in the female also similar to that species. Rostrum of female short, generally acute, but sometimes obtuse; that of male varying in length, rarely so long as in *E. rivolensis*, and mostly more pointed. Tail-piece with dorsal plates fringed with about 16 subequal little denticles, and anterior to the setae generally three slender and relatively long curved ones, gradually increasing in length anteriorly. Caudal claws and terminal teeth of dorsal plates slender, the former with inner margin feathered for not more than half their length.

*Length* of largest female in my collection, 9.5 mm.; that of male, which are much fewer in numbers, 8.25.

*Locality*.—Elwood, southern area of Victoria.

#### SYNOPSIS OF LOCAL SPECIES.

Anterior and posterior edges of shell nearly equal, and narrowly rounded, lines of growth about four, not meeting closely together at the antero-dorsal angle; end of tail, below, at the articulation of caudal claws, with a pair of conspicuous acute



processes; caudal claws almost straight, and feathered for most of their length. Male with rostrum short and acute; subapical cylindrical appendage to hands two-jointed.—*dahli*.

Shape of shell rather like preceding species, although deeper and subtruncated in front, never produced in front of the anterior end of the hinge as in following species, back of female generally greatly vaulted; lines of growth about four, meeting closely together at antero-dorsal angle; caudal claws slender, feathered for not more than half their length.—*victoriensis*.

Shell in front produced in a broadly rounded curve somewhat beyond the level of the end of the hinge, never immediately receding therefrom; rostral expansion of male very long and usually bluntly rounded; subapical cylindrical appendage of hands three-jointed.—*rivolensis*.

This species may be a synonym of *sordida*.

#### Genus 2—*Paralimnadia*, G. O. Sars.

This genus has been suggested by Sars for the following species, but so far is undefined by a description.

#### *Paralimnadia stanleyana*, King. (Pl. XXXIV., Fig. 2 *a, b*).

*Limnadia stanleyana*, King. Proc. Roy. Soc. Van Diemen's Land, 1855.

*Limnadia stanleyana*, King. Trans. Entom. Soc. N. S. Wales, vol. i., p. 162, pl. xi.

*Limnadia stanleyana*, Claus. Ueber den Körperbau einer australischen *Limnadia* und über das Männchen derselben. Zeitschr. f. wissensch. Zoologie, Bd. 22, 1872, p. 355, pl. xxix. and xxx.

*Eulimnadia stanleyana*, Sars. Arch. for Math. og Naturvid, Christiania, xvii., pt. 2, No. 7, pp. 16-28, pls. 2 and 3.

*Paralimnadia stanleyana*, Sars. *Id.*, xviii., No. 8, p. 15.

*Specific Characters*.—Shell much compressed, and, seen from the side, in fully grown females, subtriangular in form, umbones very prominent and occurring much nearer the anterior than posterior extremity, dorsal margin obliquely declining, ventral margin strongly curved in the middle, anterior extremity short,

rounded, anterior rather produced and obtusely truncated at the tip; shell in young specimens more regularly oval or elliptical in form, with the umbones not at all projecting. Shell in adult male much narrower than in female, seen from the side, oblong oval in form, umbones not very prominent, dorsal margin nearly horizontal, posterior extremity broadly expanded. Valves rather thin, and provided in fully grown specimens with numerous lines of growth, in young ones, as usual, with a much smaller number of such lines. Head triangular, with the frontal part narrowly produced, and having the usual affixing organ; rostral expansion in female much shorter and blunter than in male, and in both sexes defined from the frontal part by an obtuseangular notch. Legs, 17 pairs in female, 18 pairs in male; epipodites, or gills, not particularly large. The two anterior pairs of legs in male subsimilar, prehensile; hand rather expanded, with a triangular projection inside; claw very strong, and tipped by a small sucking disk, thumb obtuse, densely clothed with curved spinules and carrying a small setous lobe, subapical appendage biarticulate. Tail with about ten denticles on each side.

*Length* of adult female 10 mm., of male 11 mm. (G. O. Sars).

*Remarks.*—Professor Sars refers with doubt as a synonym *Estheria compressa*, Baird, from India, and also says *Eulimnadia sordida*, King, from N.S.W., may be specifically identical. I think it more likely, however, as previously stated, that the latter agrees with *E. rivolensis*, which I have had an opportunity of examining and Sars had not.

*Distribution.*—Coogee, N. S. Wales (King); near Sydney (Sars); and, if Baird's *Estheria compressa* is really a synonym, also in India.

### Genus 3—*Limnadopsis*, Spencer and Hall, 1896.

#### 1. *Limnadopsis birchii* (Baird).

*Estheria birchii*, Baird. Proc. Zool. Soc. London, 1860, p. 392, pl. lxxii., fig. 1 *a-e*.

*Limnadopsis squirei*, Spencer and Hall. Report Horn Expedition, ii., p. 239, figs. 15-19.

Messrs. Spencer and Hall agree with me that their *L. squirei* is in specific agreement with Baird's *Estheria birchii*—which, however, is a normal *Limnadopsis*.

The species has been well described and figured by Spencer and Hall.

*Distribution.*—Namoi River, N. S. Wales, in error originally printed Wamoi River, South Australia (Baird); Alice Springs country between Oodnadatta and Charlotte Waters, Central Australia (S. and H.).

## 2. *Limnadopsis tatei*, S. and H.

*Reference.*—*Loc. cit.*, p. 241, figs. 20-27.

*Distribution.*—Between Oodnadatta and Charlotte Waters, Central Australia (S. and H.); Wintinorina, near Lake Eyre (collected by Mr. H. J. Grayson).

## 2. *Limnadopsis brunneus*, S. and H.

*Reference.*—*Loc. cit.*, p. 243, figs. 28, 29.

*Locality.*—Near Port Darwin, Northern Territory of South Australia.

### SYNOPSIS OF SPECIES (partly after S. and H.)

1. Dorsum of shell well arched. Length over 20 mm. Legs, 32 pairs. Telson with dorsal spines numerous and about equal in size. Carapace very minutely pitted. Maximum number of ridges, 15.—*birchii*.
2. Dorsum generally straight. Length less than 15 mm. Legs, 26 pairs. Telson with dorsal spines few and very irregular in size. Maximum number of ridges, 13.—*tatei*.
3. Shape subequal to preceding, but dorsal spines regular and very small, Carapace pustulate. Ridges about 34. Colour, rich brown.—*brunneus*.

### Genus 4—*Estheria*, Rüppell.

1. *Estheria packardi*, Brady. (Pl. XXXIV., Figs. 3 *a, b, c*).

Brady, Proc. Zool. Soc. London, 1886, p. 85, fig. C. Sars, Arch. for Math. og Naturvid, Christiania, xvii., pt. 2, No. 7, pp. 28-35, pl. 4, 5. Sars, Development from ova, *op. cit.*, xviii., No.

2, pp. 1-17, pls. 1-4. Spencer and Hall, Report Horn Expedition, Zoology, ii., p. 236, figs. 9-14.

Synonym? *E. boysii*, Baird.

*Specific Characters*.—Shell tumid, seen from the side ovoidal, varying somewhat in shape, of firm consistency. Umbones well defined, occurring much nearer anterior than posterior end. Ridges numerous, varying in number in different varieties. Sculpture between ridges formed by more or less radiating lines. Dorsal tail-plates thickly fringed with small acute denticles. Segments of trunk dorsally with many spines. Distal dorsal limit of head always distinctly produced backwards as a lappet to overlie the following cervical segment. Scarcely swollen in front of eyes.

*Distribution*.—Lake Bonney, near River Murray, and Fowler's Bay, both in southern area of South Australia (Brady, typical variety). Common in waterholes along the Finke and its tributaries, also in the Macumba and Stevenson Rivers, Central Australia (S. and H., three varieties); Hay, N. S. Wales (Sars, typical variety). Typical variety common in many places in Northern and Southern Victoria; and if Sars is right in thinking *E. boysii* specifically identical, also India.

The following four varieties have been determined by Spencer and Hall:—

*Estheria packardi*, var. *typica*.

Length of adult shell about 9 mm. Spirit specimens dark brown. Ridges, about 24; sculpture, well defined radial straight lines, with their inner ends branching.

*Estheria packardi*, var. *cancellata*.

Shell more tumid than the preceding variety, but about similar in size. Ridges, 30-40, crowded towards the margin; sculpture strongly marked, towards the margin with the crowded ridges cancellated, and their inner edge moniliform.

*Estheria packardi*, var. *minor*.

Shell moderately tumid, smaller than above (about 4 mm.). Dorsum declining posteriorly behind the umbones. Umbones very prominent. Ridges very numerous (about 30), beset with

long white setae; sculpture not so strongly marked as in the preceding variety and without any moniliform appearance.

2. *Estheria elliptica*, G. O. Sars. (Pl. XXXVI. Fig. B).

Arch. for Math. og Naturvid, Christiania, xix., No. 1, pp. 12-17, pl. 2.

*Specific Characters, Female.*—Shell, seen laterally, of a rather regularly elliptical form, anything but equilateral, the umbones placed far in front, dorsal margin behind the umbones nearly straight, and not angular behind, free edges of valves evenly curved throughout, both extremities being rounded and nearly equal, though the anterior one appears a little more obtuse than the posterior; seen from above, rather tumid, greatest width in front of the middle, posterior extremity more pointed than the anterior. Valves of rather firm consistency, with 14 very strongly marked and elevated, ridge-like, concentric lines of growth, each provided in their posterior part with short, stout bristles, surface between the lines finely and irregularly reticulate, marginal area rather broad, and furnished with numerous densely crowded concentric striae, which are not at all raised. Upper surface of head bent at nearly a right angle close to cervical impression, rostrum somewhat blunted at the tip. Number of legs, 22-23 pairs. Tail of usual shape, with a single pair of dentiform projections at the base dorsally, caudal plates produced beneath into strong unguiform processes, and each having along the dorsal edge numerous (from 20-30) denticles of unequal size, caudal claws slender, without any setae at the base, but having their outer part distinctly denticulated along the concave edge. Colour, dark reddish brown. Length of adult female scarcely exceeding 5 mm. (G. O. Sars).

*Locality.*—Near Roebuck Bay, West Australia (G. O. Sars).

3. *Estheria sarsii*, sp. nov. (Pl. XXXV., Figs. 1 a-f).

*Description of Male.*—Shell moderately tumid, of firm consistency, seen from the side ovoidal, umbones much nearer the anterior than posterior margin, very wide, and extending very much above the dorsal line. Dorsal hinge considerably longer

than half the length of the shell, terminating posteriorly in a distinct obtuse angle, thence declining obliquely hindwards, and later merging into ventral margin in a narrow curve. Front deep, leaving dorsal line without any angle, thence forming a regular broad curve, set vertically. Ventral margin evenly convex. Lines of growth, about ten ridges, each fringed with short, thick bristles; sculpture reticulate near the margin, becoming irregularly hexagonal more distally.

The animal is crowded within the shell, and quite normal to the genus. It is characterised by a very prominent rounded area in front of the confluent eyes, and the upper posterior limit of the head segment projects backwards a little, but not nearly so marked as in *E. packardi*.

The branchial feet, compared with *E. packardi*, are considerably broader, and the stylet produced from the fifth endite (calling the coxal lobe the first) is only one—not two—jointed. The hands of the two first pairs of legs are subquadrate, being wider proximally than *E. packardi*; the margin of the outer side is almost straight, the inner straight for half its distance, when it is abruptly cut inwards, forming a right-angled projection. This marks the origin of the thumb, which is half the length of the hand, and is directed directly downwards, not deflected outwards as in *E. packardi*; also in that species the inner margin gradually widens from the proximal to the distal end, unbroken by any angular projection.

The last few segments of the trunk have no spines, or only minute ones, but more anteriorly they have a transverse series of slender ones gradually increasing in size and number (about 10), but these are not set on such prominent elevated projections, nor are they quite so numerous, as in *E. packardi*.

The tail segment is short and deeply concave above; in front of the anal setae there is a single pair of short, straight denticles, broad at the base and acutely pointed. The paired ridges bear but a few very small irregularly set denticles, and terminate in a stout upturned and curved one of normal size, that of each plate being, as is usual in the genus, deflected at different angles. The movable claws are comparatively short, and the inner margins clothed with feathered setae for about half their length.

*Size*.—Length of shell, 8 mm.; depth, 5 mm.

*Locality.*—Lake Aurean, Murchison, West Australia, in association with *Artemia westraliensis* (collected by J. T. Markes, Esq., January, 1896).

*Remarks.*—I have but one example of this species, a male. It differs materially from *E. elliptica*, another West Australian species (of which only the female has been described), in the shape of the shell, and, although of much larger size, in a rather less number of ridges, also by not possessing the numerous secondary lines of growth near the outer margins. It is named in compliment to Professor G. O. Sars, the renowned carcinologist.

#### 4. *Estheria lutraria*, Brady. (Pl. XXXV., Fig. 2 *a-e*).

Brady, Proc. Zool. Soc. London, 1885, p. 85, fig. B; Spencer and Hall, Report Horn Expedition, Zoology, ii., p. 234, figs. 4, 5.

Shell very large, reaching 14 mm. in length, and moderately tumid. Dorsum straight for almost its total length, abruptly curving into posterior margin without any angle, thence obliquely receding anteriorly. Umbones small, narrowly pointed, and very near the anterior limit. Front broadly and evenly rounded, meeting the dorsum in an obtuse angle. Ridges equidistant, 12-16, sometimes with fine bristles, sculpture between irregularly reticulate. Mature forms with tail very short, dorsal lamellae deeply concave (younger forms longer and not so concave), denticles small, few (about 5), one pair in front of anal setae straight and comparatively short, caudal claws thickly clothed on inner margin for half their distance with feathered setae. Dorsum of last few trunk segments without spines, or sometimes very minute ones. Distal dorsal limit of head meeting the hind margin in a right angle. Eyes confluent, area in front conspicuously swollen. Third pair of legs in male with fourth endite having the lower angle produced downwards as a definite little finger-like process tipped with a few setae; articulated stylet of fifth endite one-jointed.

*Length* of largest shell seen by me, 14 mm.

*Distribution.*—Innamineka, Central Australia (Brady); valley of Stevenson River, and head of the Anna Creek, Central Australia (S. and H).

5. *Estheria dictyon*, S. and H. (Pl. XXXVI., Fig. A).

Report Horn Expedition, Zoology, ii., p. 236, figs. 6-8.

Shell much smaller (about 8 mm.) than *E. lustraria*, more compressed, of a thinner consistency, but quite similar in lateral outline to *E. lustraria*. Ridges equidistant (about 10), bearing stout bristles, sculpture forming irregularly hexagonal spaces. Dorsal plates bearing about eight long, slender denticles, anterior pair in front of anal setae very long, slender, and curved hindwards. Dorsum of last few segments of trunk each with a stout spine, more anteriorly with four transversely set ones; caudal claws unclothed, or bearing but few feathered setae. Head agreeing with *E. lustraria*, but eyes not confluent, separated by a narrow line.

*Locality*.—Palm Creek, in the James Range, Central Australia (S. and H.).

*Remarks*.—I am inclined to regard this as but a young form of *E. lustraria*; the specimens I have are rather macerated, and scarcely well enough preserved to allow of the dissection of the animal; also there are no males for comparison.

## SYNOPSIS OF LOCAL SPECIES.

1. Shell more or less tumid, umbones well defined and placed far in front; ridges comparatively very many, sculpture, radiating lines variously formed. Upper distal extremity of head produced to a distinct linguiform projection overlying the distal part of cervical segment. Dorsal denticles of tail-piece small, very numerous, and unequal in size.—*packardi*.
2. Shell seen laterally of a rather regular elliptical form, ridges about 14 in number and near the margin many secondary lines of growth. sculpture irregularly reticulate. Upper distal extremity of head, seen laterally, bent at nearly a right angle; rather prominent in front of eye; tail similar in shape and armature to previous species, caudal claws rather slender, without any feathered setae at the base, their outer part distinctly denticulated.—*elliptica*.



3. Dorsal line terminating posteriorly in a distinct angle, margin thence declining obliquely; front deep and boldly curved, umbones very large and prominent, ridges about 12, equidistant; sculpture reticulate near the margin, becoming irregularly hexagonal more distally. Head in lateral view with upper distal extremity produced hindwards a little, forming an acute angle with the apex rounded off; very prominent in front of eyes. Tail possessing very few irregularly placed little denticles.—*sarsii*.
4. Shell large, long, and tumid, back straight for almost its total length, umbones very small and quite near the anterior limit, ridges equidistant, 12-16, sculpture irregularly reticulate. Head in lateral view sharply bent at a right angle and projecting considerably beyond the level of the cervical segment; a little prominent in front of the confluent eyes. Tail-piece with dorsal denticles small, few (about 5), only one comparatively short pair in front of anal setae.—*lutraria*.
5. Lateral outline of shell quite similar to above, but more compressed, of thinner consistency and smaller size: ridges equidistant, about 10, sculpture well defined irregularly hexagonal spaces. Eyes separated by a narrow space. Tail-piece bearing about eight long slender denticles, one pair in front of anal setae very long, slender, curved hindwards. Caudal claws with none or very few feathered setae at the base.—*dictyon*.

Genus—*Cyclestheria*, G. O. Sars, 1887.

*Cyclestheria hislopi* (Baird). (Pl. XXXVI., Fig. C 1, 2).

*Estheria hislopi*, Baird. Proc. Roy. Soc. London, xxlvii. (1859), pl. lxiii., fig. 1.

*Limnadia hislopi*, Brady. Journal Linn. Soc., xix., p. 294, pl. xxxvii., figs. 1-3.

*Cyclestheria hislopi*, Sars. Vid. Selsk. For., Christiania, 1888, No. 1, pp. 6-60, pls. i-viii.

Shell somewhat tumid, with the valves rather thin and pellucid, irregularly rounded, dorsal line in adult females very strongly

curved and sometimes almost angular in the middle, umbones close to the anterior extremity, rather prominent lines of growth, in adult specimens, 6-7. Cephalic crest evenly curved dorsally, rostral part obtusely rounded and finely serrated above. Ocellus nearly as large as eye. Antennae with both branches seven-jointed, scape provided at the end above with two or three expansions, densely supplied with recurved spines. Caudal plate with 7-8 pairs of dorsal spines, besides the slender terminal claws, last pair largest, and armed at base with a row of about 10 small secondary denticles. Colour, clear yellowish or corneous, more or less tinged with green.

*Size*.—Length of shell in adult ♀ attaining 5 mm., height nearly the same. (Sars).

*Distribution*.—Near Rockhampton, Queensland (Sars); Nagpur, India (Baird); Ceylon (Brady); Celebes, East Africa, Brazil (Sars).

#### Family 2—*Lynceidae*.<sup>1</sup>

*Characters*.—Shell very tumid; the valves without lines of growth, and connected dorsally by an imperfect hinge. Head of enormous size, ending in a downward-curved rostrum of a different form in the two sexes. Trunk comparatively short and massive; tail rudimentary. Number of legs not exceeding 12 pairs, only the first pair in the male prehensile. (Abbreviated from Sars).

Genus—*Lynceus*, Müller, 1785.

Syn.—*Limnetis*, Loven; Hedessa, Lièvin.

*Generic Characters*.—Shell more or less spherical, smooth, and without distinct umbones. Head carinated medially, and produced in the female to a more or less pointed rostrum, in the male to one abruptly truncated; at the sides of the head a well-developed arcuate fornix. Caudal part very small, not bent downwards, and without dentated lamellae, but covered beneath by an opercular lamella. Twelve pairs of legs in the female, in the male ten. (Abbreviated from Sars).

---

<sup>1</sup> I have followed the Rev. T. R. R. Stebbing, who, by the law of priority, restores the genus *Lynceus* in place of *Limnetis*.—The Zoologist, Mar., 1902.

1. *Lynceus macleayana* (King). (Pl. XXXVI., Fig. D 1, 2, 3).

*Limnetis macleayana*, King, Proc. Roy. Soc. Van Diemen's Land, 1855, p. 70. Trans. Ent. Soc. N. S. Wales, vol. i., p. 161, pl. xi. Sars, Archiv. for Math. og Naturvid, Christiania, xvii., No. 2, pp. 35-43, pls. 6-7.

I have collected this species from swamps at Elwood, Southern Victoria, and have also identified it in a collection of Entomostraca received from Mr. C. Gabriel from St. Arnaud, Northern Victoria. The specimens are without any differences either in form or size from Professor Sars' very careful drawings and descriptions. King's specimens came from near Sydney, and those of Sars' from Hay, N. S. Wales.

*Length* of adult female, 7 mm.; male about the same.

2. *Lynceus tatei* (Brady). (Pl. XXXVI., Fig. E, 1, 2, 3).

*Limnetis tatei*, Brady, Proc. Zool. Soc. London, 1886, p. 84. Sars, Archiv. for Math. og Naturvid, Christiania xvii., No. 2, pp. 43-46, pl. 8.

Specimens collected by me at Rosstown and Elwood, Southern Victoria, differ in no fundamental features from Sars' description, but many were much larger, the females reaching the length of 6.3 mm. and males 5.75 mm.

Brady's specimens came from near Rivoli Bay, South Australia, and Sars' from near Sydney, New South Wales.

3. *Lynceus eremia* (S. and H). (Pl. XXXVI., Fig. F, 1, 2, 3).

*Limnetis eremia*, Report Horn Expedition, Central Australia, pt. ii., 1896, p. 244, figs. 30, 31, 32.

*Locality*.—Cooper's Creek, Central Australia (S. and H.).

SYNOPSIS OF LOCAL SPECIES.

1. Shell very tumid, nearly globose, seen from the side somewhat irregularly rounded, greatest height not nearly attaining the length and occurring in front of the

middle, dorsal margin boldly curved anteriorly, almost straight and obliquely declining behind, ventral margin evenly curved and passing into the anterior and posterior edge without any intervening angle, anterior extremity broader than the posterior. Female with rostral expansion in front view very broad, obtusely rounded at the extremity, without any lateral projections; that in the male transversely truncated, lateral corners scarcely produced.—*macleayana*.

2. Shell less tumid than preceding species, in lateral view subcircular, nearly as high as it is long, dorsal margin sloping rather steeply behind, anterior extremity very broad and blunted, posterior narrow and rounded. Rostral expansion in female much produced, frontal view, narrow linguiform, with a distinct notch on each side of the obtusely rounded tip; in the male with distal lateral edges projecting beyond the apical face.—*tatei*.

3. Form of shell resembling the preceding one, but with posterior extremity much more narrowly rounded. Rostral expansion in both sexes shorter and more constricted in the middle than either of the former species; that of the female notched on each side near the apex; in the male rapidly expanding distally, lateral edges not projecting beyond the face.—*eremia*.

## TERMINOLOGY AND EXPLANATION OF PLATES, XXVII.—XXXVI.

### DIVISIONS OF BODY :

C. Cephalon (1. Head segment. 2. Cervical Segment).  
Ms. Mesosome or Trunk. T Metasome or Tail.

### APPENDAGES OF CEPHALON :

A<sup>1</sup> Antennulae or first antennae. A<sup>2</sup>. Antennae or second antennae. F.A. Frontal appendages of Branchipodidae.

H. Affixing on Haft organ of certain Limnadiidae.  
Lp. Lip. M. Mandibles. M<sup>1</sup> M<sup>2</sup> First and second  
Maxillae. (Eyes and ocellus).

APPENDAGES OF MESOSOME :

L. Branchial legs with respective number added. (C.P.  
Covering-plate. G. gill. E. exopodite. En<sup>1</sup>—En<sup>6</sup>,  
endites).

APPENDAGES OF METASOME :

C.R. Caudal rami and Caudal claws. In Branchipodidae the  
two first segments (genital segments) bearing Ov. ovary,  
or P. penes, in respective sex. E. egg.

PLATE XXVII.

*Artemia australis* ♀.

PLATE XXVIII.

A. *Artemia westraliensis* ♀. B. *Parartemia zietziana* ♀.

PLATE XXIX.

*Parartemia zietziana* ♂.

PLATE XXX.

*Branchinella australiensis* (Richters). 1. Small ovigerous  
female, side view. 1a. Extremity of second antennae.  
2. Head and appendages of male. 2b. Armature of  
inner surface of first joint of claspers. 2a. Right hand  
branch of frontal appendage. 3. Portion of tail show-  
ing ovary of large sized female. 4. Portion of tail of  
male showing internal generative organs of one side,  
with sheath of penis protruding outwards. 5. Similar  
to preceding but with the two penes everted from their  
sheaths. 6. Penis of left side more highly magnified.  
7. Fifth branchial leg of small sized male.

PLATE XXXI.

*Branchinella eyrensis*.

PLATE XXXII.

*Eulimnadia rivolensis.*

PLATE XXXIII.

*Eulimnadia victoriensis.*

PLATE XXXIV.

1. *Eulimnadia dahli*, after Sars.
2. *Paralimnadia stanleyana*, after Sars.
3. *Estheria packardi*.

PLATE XXXV.

1. *Estheria sarsii*.
2. *Estheria lutraria*.

PLATE XXXVI.

- A. Tail-piece of *Estheria dictyon*.
  - B. *Estheria elliptica*.
  - C. *Cyclestheria hislopi*.
  - D. *Lynceus macleayana*, lateral view of shell, and front view of head of male and female.
  - E. *Lynceus tatei*.
  - F. *Lynceus cremia*. (B, C, D and E drawn after Sars, F after Spencer and Hall).
-